144

SCIENCE

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CONTENTS.

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SCIENCE

TENTH YEAR.

The use of *Science* by scientific men has increased in the past few months as never before. More than **two hundred of the leading scientific men and women** of America **have agreed to contribute** to the paper during the coming year; and, as others are constantly joining in this move, to make the paper more valuable than ever, it cannot be long before there will be a body of **five hundred competent users of this weekly medium of scientific discussion.** It is our aim to place the paper in the hands of all competent persons who will avail themselves of this opportunity to make *Science* a better representative of American scientific work than ever in the past.

N. D. C. HODGES, 874 Broadway, New York.

QUERY.

Can any reader of *Science* cite a case of lightning stroke in which the dissipation of a small conductor (one-sixteenth of an inch in diameter, say,) has failed to protect between two horizontal planes passing through its upper and lower ends respectively? Plenty of cases have been found which show that when the conductor is dissipated the building is not injured to the extent explained (for many of these see volumes of Philosophical Transactions at the time when lightning was attracting the attention of the Royal Society), but not an exception is yet known, although this query has been published far and wide among electricians.

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N. D. C. HODGES,
874 BROADWAY, NEW YORK.

SCIENCE

NEW YORK, FEBRUARY 12, 1892.

ON THE TEACHING OF ANATOMY TO ADVANCED MEDICAL STUDENTS.[1]

THE importance of anatomy to the physician and surgeon has caused the method for teaching this science to be largely determined by practitioners. The student is taught the elements of histology, the shapes and numbers of organs, the outlines of regions, and their mutual relations. Other facts than those named belong in a very remote degree to the needs of practice; and when the great number of medical topics is considered, which is of necessity brought to the attention of the student, it is no wonder that governing bodies are disposed to disregard all phases of instruction that do not have direct claim upon the physician's time and service.

But science is rarely pursued for practical good. The acquisition of knowledge for its own sake — the determination of general principles that reveal the existence of law — awakens and maintains pleasures and interests in the mind of the anatomist compared with which the practical uses that he can make of the knowledge appear to be poor and mean. With as much propriety one might say that navigation is the highest use that can be made of the study of astronomy, as to assert that the chief end of the study of anatomy is to apply its tenets to medicine. These statements are made not to lessen the dignity and importance of practical work, but respectfully to claim that such work does not comprise all the value, indeed scarcely more than a small fraction of the value, that pertains to the whole.

In his "New Atlantis," Lord Bacon says: "We have three of our fellows that bend themselves, looking into the experiments of others, and cast about how to draw out of them things of use and practice for man's life, and knowledge, as well for works as for plain demonstration of causes, means of natural divinations, and the easy and clear discovery of the virtues and parts of the bodies. These we call dowry-men or benefactors. Lastly, we have three that raise the former discoveries by experiments into greater observations, axioms, and aphorisms. These we call the interpreters of nature."

I hear a response to the foregoing statement that the structure of animals exhibited on a broad scale is already taught to classes in the scientific schools, and that, in the scheme of a university education, the biological subjects are as well advanced as any others in the curriculum. This is an imperfect, if not misleading, presentation of the facts. It is true that the rudiments of the structure and functions of animals and plants are taught. But to students already advanced by general training and by preliminary work in natural history, little is presented that prepares them to discuss the more intricate problems.

To my mind the scheme of university work is unsatisfactory until opportunity is afforded to men, who, after completing their biological and medical training, may desire to still further advance. Conceding that the question of maintenance has been settled, either by the possession of private means or by endowment of fellowships, what courses of instruction are afforded these advanced men? As a rule, nothing, or next to nothing. It is customary for such novitiates to reside abroad for several years, where, amid numerous centres of learning are found one or more masters, the disciples of whom they become. The advantages of travel being considered, it may be said that with the comparatively easy means of obtaining the best instruction the present scheme is on the whole adequate. With such a conclusion I cannot agree. If it were true, we might in reason have stopped long ago in our lines of university expansion. Independence in intellectual as well as in political life should be the object of American citizenship.

First, and always, let us remember that medical investigators are those it is desired to train. It is for men that are already imbued with the desire to pursue their researches in anatomy that I appeal. They stand in this field with what preparations can be given them for usefulness. They are medical biologists — medical anatomists. They are not restricted to the problem of the relief of suffering, and yet they are occupied with those other problems upon which the true solution of all depends.

For such instruction I would have a specially-designed museum and a specially-equipped laboratory. It may be assumed that in every great medical school, from among the large number of matriculates (men already trained and of the best quality), two or three of the type described will present themselves for an advanced course in anatomy. I am prepared for the objection that this is too large a number. But, so far as I know, no one has attempted to ascertain how many men in each class of graduates would come forward, and my impressions are based upon the number of workers in the general field of biology — some of whom, at least, would have pursued these or similar studies had any systematized course been presented to them. I will, therefore, begin with three men a year. To this number may be added as many young teachers, tutors, curators, and prosectors, who would avail themselves of the instruction. The work might be initiated in either of the halls of biology or of medicine. If the course were well established, it would be well to institute a laboratory and museum distinct from any on the university grounds. I am of the opinion that the administrative success of such separation of collections would be assured. All must approve of the ethnological collection of Harvard being distinct from the Museum of Comparative Zoology, and of both in turn being set apart from the museum in the Medical School. In like manner, I assume that there is no reason why series of specimens arranged in illustration of principles that are not taught either in the preliminary or in the proper medical courses, should be necessarily connected with one or the other museum. The collections should be in the main designed to accommodate the preparations that are used in the illustration of general lectures. Museums that teach by the specimens being removed from the cases to the lecture halls are radically distinct from museums that teach by the conservation of series that are

[1] Also published in The Medical News, December 26, 1891.

arranged and labelled for instruction as they stand, and which should be rarely, if ever, disturbed.

The following, treated in some detail, embrace the topics that occur to me at this time as appropriate subjects for instruction: The study of the human brain; especially the study of the mammalian and avian brains, both of the gross and the minute anatomy, the localization of functions, etc. The study of muscular anomalies and their homologies in the normal myology of the vertebrates. The study of animal locomotion and its application to the morphology of the vertebrate limb, and in general the application of photographic methods in studying animal locomotion.[1] Studies in craniology, especially the comparative studies of human and mammalian crania. The study of osteological variations, with a similar application to the normal anatomy of the lower animals and the beginning of morbid processes. The study of nutritive processes on tissue as correlated to age.[2]

In addition, courses of experimental morphology might be essayed. Such investigation could be encouraged without encroaching on the domain of physiology, as the votaries of this science somewhat arbitrarily restrict it. Indeed, much of the study of animal locomotion would be experimental, as would also be the study of protoplasm in viscid media, under rotation, compression, etc. The effects of light, temperature, water in motion and at rest, etc., on organization, would naturally find a place. Experiments on mutilation of embryos might also be undertaken.

Lectures on correlation of structure, on vegetative repetition, on the relation existing between phyllogenetic and teratological processes, could be given, as well as the study of the laws of heredity, especially in attempting to answer the question of the transmittal of acquired characters.

The teeth are so responsive to the constitutional peculiarities of the individual that their peculiarities can be seen and readily detected. The method of procuring accurate impressions can be applied, and the plans of preserving the form of teeth be easily accomplished.

As is known to the zoologist, the parts involved in the act of mastication are important in the classification of the mammalia, the slightest departure in the form, number, position, and rate of development of the teeth being for the most part correlated with other variations in the economy, while the shapes of the lower jaw and of those portions of the skull that afford surfaces for attachment of the masticatory muscles are of importance. No structures of the body resemble the teeth in the character of their response to morbid impressions; no other organs are arranged in progressive series; and none other than these are evolved after birth. Hence the effects of disease and accidents to which the teeth are subjected are sure to be recorded in the shapes of the crowns and roots.

If the student of heredity were to have placed at his disposal a collection of the casts of the permanent teeth of three generations — that is to say, of the parent of the subject, the subject himself, and the children of the subject — and if a clinical history were secured of the diseases and accidents that these persons had incurred, a tenable argument might be established as to the significance of the contrasts or resemblances in the forms of the teeth.

Thus, if three generations were expressed by the letters A, B, C, and if B is the subject of an acquired character (let us say from scarlet fever or measles), the new form of structure seen in the second and third molars may be transmitted to C. But in order to prove this it is necessary to know the peculiarities of these teeth in A. Hence, the teeth of the ancestors and descendants of the person who exhibits the acquired character must be known. A somewhat similar plan of observation could be made on the teeth of the lower animals. It is strange that those teeth with endless pulps, in which growth is rapid and interference with their relations causes permanent records to be made in malformation, should not have been used in studies of nutrition.

In connection with myological studies a number of minor problems suggest themselves; such, for example, is the nature of white and red muscles. It has been noted that in ostriches that have been confined in zoological gardens the muscles of the leg undergo fatty degeneration and become white in color; it is also known that the pectoral muscle in many of the gallinæ is white, presumably from the fact that they are used but for short and infrequent flights. How evident is the conclusion that a systematic study of all muscles of active birds living in enforced confinement, as compared with the relatively active muscles in feral forms, might be undertaken with a fair prospect of throwing light upon the nature of the process, and with a hope that the subject of fatty degeneration (even if by this method not elucidated) may have its study placed on a broad basis by subjecting its tenets to the tests of systematized experiment and observation!

The morphological study of the results of diseased action might also be undertaken. The differences that obtain between normal individuals and those the subjects of hereditary disease must be of importance to the anatomist and the pathologist.

The variations in the forms of the bones, as found in medical museums, are of a character that suggest their relation to inherited causes. Every clinical observer has noted the peculiar shape of the chest in families in which pulmonary phthisis is hereditary, even though the special tuberculous deposits are absent in some of its members. The clubbing of the finger-nails is a sign of the same disposition. Some writers, indeed, claim that in this class of subjects a special arrangement of the fibres of the pneumogastric nerve exists. Are these and similar morphological characters susceptible of being also gathered so as to contribute to the discussion of the transmission of acquired characters? Are not opportunities here presented for the medically trained biologist to study the subject of heredity in a line so important and, alas! with material so abundant? Other hereditary diseases, such as struma, syphilis, and gout, are less strongly marked than is the tuberculous, but even on this obscure horizon landmarks are detected that are of sufficient definiteness to guide the observer to well-defined plans of study. The animals of zoological gardens exhibit examples of acquired struma, the effects of which more especially distinguish the skeleton. Can any of these characteristics be transmitted? How would the skeleton of a tiger, let us say, born in captivity in the third and forth generation differ

[1] Instantaneous photographs have given us definite conceptions of the behavior of the manus and pes in terrestrial and aerial movements. I had the honor to point out as a result of a study of the negatives taken by Mr. E Muybridge under the auspices of the University of Pennsylvania, that the ground is touched by the outer border of the foot and is left by the inner border, and that the impact represented by this transition is expressed by an oblique line that extends from without inward (ecto-entad) across the metapodium. Professor H. F. Osborne, by studying the carpus and tarsus in extinct forms of mammalian life, has found that this conclusion is of value in studying the evolution of the parts. From this we can conclude that, as a result of a photographic plant in connection with advanced anatomical work, discoveries could with some confidence be anticipated.

[2] This would form a morphological study on the nature of age, and would more particularly embrace a consideration of the immature and senile forms as compared with the typically adult, as well as the retention of juvenile characters in the adult.

from that of a feral type? After what manner may one expect taxonomic characters modified in these generations of prisoners?

The nature of malignant growths, it is not improbable, would find a solution in a line of research based upon a similar proposition. What proportions of malignant growths, such as the sarcomata, are met with in the feral state of quadrupeds as compared with those in the domesticated or the captive state? Can experiments be devised by which we may expect to cause these growths to appear by creating the favoring conditions? Can we study the genesis of the sarcomata to better advantage than has hitherto been done, by outlining the biography, the lineage, and to some extent possibly the destiny, of these tumors, by applying to them experimental methods of research?

Medically trained men are not apt to become pure morphologists. The underlying thought is of *function* through which *structure* is modified. In its best sense, therefore, physiological anatomy is the branch of science that would be most developed. Let us suppose that John Hunter had lived in 1891 and had essayed his work by all the aids of modern science, and had undertaken a plan of investigation for the continuation of his labors: might he not have accepted some such scheme as I have feebly attempted to portray? With the admiration we feel for his genius, let us not only have Hunterian orations, but in each medical centre a Hunterian laboratory and a Hunterian museum.

"I am so utterly opposed to those cloud-builders who would divorce physiology from anatomy," says Haller, "that I am persuaded that we know scarcely anything of physiology that is not learned through anatomy" (quoted from R. Cresson Stiles's "Life and Doctrines of Haller," New York, 1867).

In Solomon's house, in the "New Atlantis," in which Bacon essayed a scheme for intellectual advancement, we read of "parks and enclosures of all sorts of beasts and birds, which we use not only for view or rareness, but likewise for dissection and trials, that thereby we may take light what may be wrought upon the body of man; we have also particular pools where we make trials upon fishes, as we have said before of beasts and birds."

I hear objections that this scheme is visionary and impracticable. How is the money to be obtained by which it can be rendered feasible? Where is the teaching-force to be recruited? My answer is that if the need of establishing such a course be acknowledged, the accomplishment of the end in view is no more difficult than in any other branch of pure science. A few years ago the establishment of seaside laboratories would have been thought chimerical. Now they are assured successes.

If I am told the results obtained will appeal to but few, I reply that important projects must be supported in proportion as they so appeal, until such time as they shall have proved their right to exist. HARRISON ALLEN.

TIME-SERVICE OF HARVARD COLLEGE OBSERVATORY.

THE time-service of this observatory has been maintained for nearly twenty years upon the system originated by the late Professor Joseph Winlock. Continuous signals, that is, signals throughout the entire twenty-four hours instead of for a short time each day have been furnished to the cities of Boston and Cambridge, and have been used to strike the bells of the fire-alarm daily at noon. For many years a time-ball has been dropped, thus furnishing a precise time-signal to many citizens and to the shipping in the harbor. The continuous signals have been sent also to the railroads centring in Boston, and to the Boston office of the Western Union Telegraph Company, and have been distributed by them over a large part of New England. Many cities and corporations, although not subscribing for the time-signals, have been in the habit of taking them from the railway and telegraph stations, thus extending their use. The time-service in New York City was thus supplied with our signals for many years. The signals, again, have been furnished to the principal jewellers in Boston and vicinity, and used by them in the rating of fine watches. The lines transmitting the time-signals in these various directions affected the telephone lines by induction and otherwise, and thus many other persons obtained the signals by merely listening at the telephone.

The subscriptions of the city of Boston and of the railroads, and the receipts from the jewellers were sufficient to defray the cost of furnishing the exact time, and for some years formed a source of revenue to the observatory. No charge was made to the city of Cambridge or to the Western Union Telegraph Company. The expenses were, however, large, since it was necessary to duplicate the instruments and clocks employed, although the cost of the necessary duplication of the lines connecting the observatory with Boston was diminished by the arrangement with the Western Union Telegraph Company. For several years, also, the city of Cambridge rendered similar assistance. Although the best clocks were used and mounted in vaults specially constructed so as to secure a uniform temperature, great care was necessary to keep not only the errors, but also the changes in daily rate, as small as possible. It was necessary to compare the clocks frequently, and to determine their errors by observations of the stars at short intervals. Especially after several days of cloudy weather, the first opportunity was taken to secure observations, although this often occurred at inconvenient hours. Frequent interruptions took place on the lines, and it was therefore necessary constantly to have men ready to detect and repair breaks, crosses, and other injuries.

The general introduction of standard time was considered at the observatory some months before this step was taken. Since the same signals could be used throughout the entire country, it was recognized as a source of danger pecuniarily to the time-service. This argument, however, was allowed to have no weight, since it was believed that the change would be a benefit to the public. As it happened, this observatory was enabled to take an active part in making the change, since all of the railroads centring in Boston assented only on condition that our signals should be sent according to the new system. When the change had been decided upon, various steps were taken by the officers of the observatory to secure the general and simultaneous adoption of the new time by the country.

A new source of difficulty and danger in distributing time-signals has arisen during the last few years. The great increase in the number of telephone and other wires has rendered it much more difficult to maintain an unobstructed circuit. Breaks and crosses are continually occurring, especially in stormy weather; and the privilege of placing wires on housetops is every year less willingly granted. Recently a more serious danger has arisen. The currents of high tension carried by electric-light and electric-railway wires, in case of a cross, may be transmitted indefinitely,

causing danger of fire, bodily injury, or even loss of life. Pecuniary liabilities in such cases may be very great. The financial officers of the university regard such risks as more than offsetting the receipts for the time-signals.

One of the greatest advantages of the time-service to the observatory has been that it kept before the public the practical value of astronomical work. Many thousands of persons who take no interest in work of a purely scientific character recognise the great financial value to the public of an accurate system of time. The observatory desires to confer this benefit on the public, and it would be ready to do so even at a financial loss. But recently the time-signals of the United States Naval Observatory have been offered to the public at very low rates, through the Western Union Telegraph Company. This can the more readily be done since the expense of furnishing the time is borne by the people through a government appropriation, while the company has the largest facilities for the maintenance of telegraphic connections. The Harvard College Observatory is therefore relieved of this duty. If the public is to be the gainer, signals of equal accuracy and continuity must be furnished. Unfortunately, signals sent to a great distance are liable to frequent interruptions from trouble with the telegraph lines, and therefore secondary clocks must be used in each large city if continuous signals are to be distributed. These clocks must be constantly compared and corrected if great accuracy is to be attained, and it is still a question whether satisfactory results can be secured outside of an astronomical observatory. If the results prove unsatisfactory, however, the responsibility for trying the experiment will not rest upon this observatory.

In view of the facts stated above, it has been decided to discontinue the time-signals furnished by this Observatory after March 31, 1892. An earlier date would have been selected, but for the desire to give our subscribers sufficient time to make other arrangements for securing signals.

The most important events in the history of the time-service are given below. The first transmission of time from the observatory to Boston was over a line hired for the purpose and used occasionally for the comparison of clocks in Boston with the standard clock at Cambridge. From 1856 to 1862 the observatory owned a line for the same purpose. Up to the close of 1871, no charge was made for the time thus furnished, which was used for many years for striking the fire-alarm bells of Boston at noon, and for other purposes. The regular transmission of signals and the receipt of compensation for them began in 1872, the service being under the direct care of Professor Winlock, who had devised the system. After his death in 1875, Professor W. A. Rogers took charge of the service and introduced the custom of telegraphing information as to the error of the signals at a given hour daily. In 1877 Dr. Leonard Waldo took charge, and during the next year, with the liberal co-operation of the Equitable Life Assurance Company, the Boston Time-Ball was erected on top of the building of that company. In 1878, also, a correspondence was opened with the railways of New England relative to a uniform system of time and the practicability of introducing it by legislation. A plan for establishing a bureau for the testing of fine watches and thermometers was considered, and abandoned on the ground that such work would be commercial rather than scientific, and therefore not within the scope of the observatory. In 1879, Professor Frank Waldo, who had previously assisted his brother, took charge of the time-service. The error of the standard sidereal clock was determined every day at 10 A.M. from the latest comparisons with the stars, assuming the rate to continue uniform. The mean-time clock was compared with this, and for several years the difference had been communicated every day by telegraph. This practice was abandoned, since it was easy to reduce this difference to zero, and it did not indicate the true error of the clock. Especially during continued cloudy weather, large changes might take place in the rate of the sidereal clock, which could not be determined until observations could be made of the stars. At this time the signals were sent to New York, and were used in the time-service of that city in combination with similar signals sent from the Naval Observatory and Allegheny Observatory. It developed the interesting fact that the differences, sometimes amounting to several seconds, were much greater than were expected, or than would be derived from combining the supposed errors of the different time-services. This was regarded as a preliminary trial of a plan which was developed later, and appears to be the only way of effecting a great increase in the accuracy of time-signals. It is easy to keep the errors of a clock small if the weather is clear, and frequent comparisons can be made with the stars. During long periods of cloudy weather, however, when no observations of the stars can be made, it is very difficult. The slight changes of rate to which even the best clocks are liable may cause serious errors at the end of several days. The remedy is co-operation between observatories so distant that it would seldom happen that clouds would prevent observations at all of them. The time would be determined at each observatory every evening, when it was possible, and the result transmitted telegraphically to a central station; also when called for, as soon as it cleared, whatever the hour. The central station would report daily to each observatory either the results of each observation received or a corrected error derived from them all. Each observatory might send its own time or receive signals from a normal clock at the central station. Mr. J. Rayner Edmands, who has had charge of the time-service from June, 1881, to the present time, rendered important aid in forming this plan. He postponed the record of the errors occurring during cloudy weather until observations could be made for determining them. The apparent errors were thus increased, but the actual errors were represented with much greater accuracy. The practice of making the error at 10 A.M. especially small was abandoned, and attention was given to keeping the signals as accurate, and the daily rate as small as possible at all hours. The general introduction of standard time was effected at noon on Nov. 18, 1883. After the change was decided upon, a large part of Mr. Edmands's time for several weeks was devoted to securing the assent of the public throughout New England to the proposed change. In 1885, a new time-ball was erected on the Boston post-office building, with the aid of an appropriation from the city of Boston. Experiments were made in various matters associated with the distribution of accurate time. Among others, a delaying apparatus was devised, by which the signals of a clock could be retarded by any desired fraction of a second, so that, without disturbing a clock, its apparent error could be varied at will. In 1889 some interesting experiments were made by Mr. W. P. Gerrish on distributing time accurately by flashes of magnesium powder. Signals were thus sent from a station on Blue Hill, twelve miles distant. They were readily visible, and the exact time to within a fraction of a second could be taken from them. These flashes were also seen from Princeton and Mount Wachusett, forty-four miles distant, and from numerous nearer points. From an

early period in the life of the time-service, the telegraphic lines have been in charge of the electricians, Messrs. Stearns and George, and their successor, Mr. C. L. Bly.

EDWARD C. PICKERING,
Director of the Astronomical
Observatory of Harvard College.

Cambridge, Mass.

NOTES AND NEWS.

MR. J. L. KIPLING says of the monkeys of India: "They have a game like the English boys' cock of the dung-hill or king of the castle, but instead of pushing each other from the top of a knoll or dust-heap, the castle is a pendant branch of a tree. The game is to keep a place on the bough, which swings with their weight as with a cluster of fruit, while the players struggle to dislodge one another, each, as he drops, running round and climbing up again to begin anew. This sport is kept up for an hour at a time with keen enjoyment, and when one is nimble as a monkey it must be splendid fun."

—In 1890 was published the important discovery by Behring and Kitasato that blood serum taken from animals that had been rendered immune to tetanus and diphtheria was capable of curing other animals suffering from those diseases. Drs. G. and F. Klemperer (*Berliner klinische Wochenschrift*, Aug. 24 and 31, 1891) publish a research carried out in regard to pneumonia, with the object of discovering how immunity against the pneumococcus could be best produced, whether recovery from the disease rendered an animal immune, and whether it was possible to cure pneumonia by the blood serum of animals that have recovered from the disease. Their experiments, which were confined to rabbits, revealed that every nutrient medium in which the pneumococcus has been cultivated will, if inoculated, render an animal immune against pneumonic septicæmia, even after the cocci have been removed by filtration. The power of producing immunity is more speedily acquired, and is increased if the infected nutrient medium (before or after removal of the cocci) is exposed to a temperature of between 41° and 42° C. for two or three days, or of 60° for an hour or two. In every case, however, it was found necessary that some interval (varying from three to fourteen days) should elapse between the inoculation and the production of immunity. Hence it was too late to cure a diseased animal or even to prevent the onset of an attack if the injection was given simultaneously with the outbreak of the disease. On the other hand, serum taken from animals enjoying immunity was found able, especially when introduced directly into the circulation, to cure pneumonic septicæmia. The serum was injected twenty-four hours after infection, while the animals had a febrile temperature of between 105° and 106.5° F. Eight cubic centimetres were injected, with the result that the temperature gradually sank during the next twenty-four hours. In twelve successive cases a successful result was obtained. This research therefore confirms, in regard to pneumonia in rabbits, what Behring and Kitasato did for tetanus and diphtheria. Drs. Klemperer next studied the question how the blood serum of an immune animal cures an attack of pneumonic septicæmia, and discovered that when the pneumococcus is introduced into the body of an animal it generates a poisonous substance which can be isolated, and to which the name of "pneumotoxin" has been given. This pneumotoxin sets up a febrile condition which lasts several days, after which another substance is found to have been produced called "antipneumotoxin," which is able to neutralize the pneumotoxin. The serum taken from an immune animal contains this antipneumotoxin, and it is by means of this substance that it cures an attack of pneumonic septicæmia in other animals. The relation of pneumonia as seen in rabbits with that met with in man was next investigated, and the conclusion arrived at that the disease in both cases is produced by the pneumococcus, but that the human body is much less susceptible to the latter than the rabbit is. Thus it was found that serum taken from pneumonic patients after the crisis could cure pneumonia in rabbits; moreover, pneumotoxin and antipneumotoxin were found to be present in human serum as in that taken from rabbits. The crisis of pneumonia, according to Drs. Klemperer, takes place as soon a antipneumotoxin is produced in sufficient quantity to neutralize the pneumotoxin. Why immunity against further attacks lasts so short a time in man is still uncertain, but possibly less antipneumotoxin is formed in man than in rabbits in proportion to the pneumotoxin. Some attempts have already been made to cure patients suffering from pneumonia with the help of antipneumotoxin, but further observations are necessary.

—It is a well-known fact that, with the same temperature by the thermometer, one may have, at different times, a very different feeling of heat and cold. This varies with the temperature of the skin, which is chiefly influenced (according to M. Vincent of Uccle Observatory, Belgium), by four things: air-temperature, air-moisture, solar radiation, and force of wind. M. Vincent recently made a large number of observations of skin-temperature in the ball of the left hand, and constructed a formula by means of which the skin-temperature may be approximately deduced from those four elements. He experimented by keeping three of the four constant, while the fourth was varied, and a relation could thus be determined between the latter and skin-temperature. One fact which soon appeared was, that the relative moisture of the air has but little influence on skin-temperature. It was also found that for every 1° C. of the actinometric difference (excess of black bulb thermometer) the skin-temperature rises about 0.2°; and with small wind-velocities, every metre per second depresses the skin-temperature about 1.2°. In testing his formula M. Vincent found, with cold or very cold sensation, considerably greater differences between the calculated and observed values than in other cases. This he attributes to the great cooling of the relatively small mass of the hand. Taking the cheek or eyelid the results were better, says *Nature*.

—Last winter, in December and January, M. Chaix made a number of observations of the temperature of the air, the snow, and the ground at Geneva, of which he has given an account to the Physical Society there. He observed the air at four different heights; granular, pulverulent, and bedded snow, on the surface and at different depths; and the surface of bare ground as well as of ground covered with snow. There was no difference in mean temperature between the air at one and two metres; and very little between the former and that on the snow surface. The surface of the ground was 4.265° C. warmer than the surface of the snow (0.13 m. above), through arrest of radiation. But the bare ground was not cooled so much as the snow surface, and it was only 2.04° colder than the snow-clad ground. This shows the frigorific influence of snow on climate. Air passing over bare ground would have been 2° warmer than if it passed over the snow. The snow surface was sometimes warmer, sometimes colder than the air one or two metres above. In the dry winters of Siberia and Sweden, the snow-surface is generally (according to Woeikof) much colder than the air. M. Chaix explains the variations observed at Geneva by fluctuations in the relative humidity, involving alternate vaporization and condensation at the snow-surface. In two-thirds of the cases, indeed, abnormal cooling of the snow corresponded with a low humidity, and heating with a high humidity, and often formation of hoar frost at the surface, according to *Nature*.

—An illustration of the height of breaking waves is afforded by the following paragraph, which we take from the San Francisco *Chronicle* of Jan. 6: "Portland, Jan. 5 The lighthouse tender 'Manzanita' reached Tillamook Rock Sunday for the first time in six weeks, and brought away the keeper, George Hunt, who has been on the rock for four years, and has been transferred to the Cape Mars Light. He says, in the storm of Dec. 7 the waves swept clear over the house, washing away their boats, and tearing loose and carrying away the landing platform and tramway, which were bolted to the rock. On the 29th the waves were still higher, and streams of water poured into the lantern through the ventilators in the balloon top of the dome, 157 feet above the sea-level. The lighthouse was shaken to its foundation by the impact of seas against it, and the water found its way into the house. Men were on duty all night to keep the lamp burning, and but for the wire screen the shutters of the lantern would have been demolished."

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LATEST DETAILS CONCERNING THE GERMS OF INFLUENZA.

DR. R. PFEIFFER, overseer of the scientific division of the Institute for Infectious Diseases at Berlin, has the credit of discovering, isolating, describing, and inoculating the germs that are the cause of influenza. The following results are based upon his thorough investigation of thirty-one cases of influenza, in six of which autopsies were made.

1. In all cases there was in the characteristic, purulent, bronchial secretion a definite kind of bacillus. These rods were shown in uncomplicated cases of influenza, in an absolutely pure culture, and for the most part in large numbers. Very frequently they lay in the protoplasma of the pus-cells. Where the patient has been subject to other bronchial troubles, one finds in the sputum, in addition to the influenza bacilli, other micro-organisms. The bacilli can enter from the bronchi into the peri-bronchial tissue, even to the surface of the pleura, where in purulent coats in two autopsies they were found in pure culture.

2. These rods were found only in influenza. Numerous control-experiments showed their absence in common bronchial catarrh, pneumonia, and phthisis.

3. The condition of the bacilli varied with equal force in the course of the disease; first with the exhaustion of the purulent bronchial secretion the bacilli also disappeared.

4. Two years ago, at the first appearance of the influenza, I saw and photographed the same bacilli in large numbers in preparations of sputum from influenza patients.

5. The influenza bacilli appear as small rods, of about the thickness of septicæmia bacilli in mice, but one-half their length; frequently three or four bacilli are found arranged one after the other like in a chain; it is difficult to stain them with the basic-aniline dyes; one obtains better preparations with Ziel's solution and with the hot methyline blue of Löffler. In this way one sees almost regularly that the end-poles of the bacilli stain more intensively, so that forms arise which might be very easily mistaken for diplococci or streptococci. The bacilli are not stained by Gram's coloring matter; and in hanging drops they are immovable.

6. These bacilli can be obtained in pure cultures; in one and a half per cent sugar-agar the colonies appear the smallest. The continued culture in this nutrient medium is difficult, and I have not been able to go beyond the second generation.

7. Many experiments for transmission to apes, rabbits, guinea-pigs, rats, pigeons, and mice were made. Positive results could be obtained only in apes and rabbits. The other species of animals were refractory to the influenza.

8. These results justify the conclusion that the above described bacilli are the cause of influenza.

9. Infection comes very probably from the germs of the disease in the sputum; and therefore for prevention of contagion the sputum of influenza patients must be made innocuous.

Dr. Kitasato has succeeded in cultivating the bacilli of influenza to the fifth generation upon glycerine-agar.

ARTHUR MACDONALD.
Georgetown Medical School, Washington, D.C.

A SERIES OF ABNORMAL AILANTHUS LEAFLETS.

A STURDY trumpet creeper (*Tecoma radicans*) has entwined itself about an ailanthus tree which stands in our yard, near the veranda. Together, they form quite a charming bower during the summer time, when the bright trumpet flowers are so profusely intermingled with the dark green foliage of vine and tree.

It was here that I had taken my chair one afternoon, to enjoy an hour's undisturbed reading. My anticipations of quiet, however, were very soon interrupted, by a sudden gust of wind, which set the leaves of my book a-fluttering so, that I was obliged to close it. But "it is an ill wind that blows nobody good," I said to myself, as I stooped to pick up some leaflets which came fluttering down from the ailanthus tree.

Although it was only June, these leaflets were of a bright yellow color, like the tints of early autumn. But what attracted my attention especially was their variation from the typical form. Every leaflet had a peculiar notch, lobe, or lop-sided outline which would cause it to be classed among monstrosities, or abnormal leaves. These abnormal specimens were more to me, however, than mere "freaks of nature." They were the tablets on which their own history was inscribed.

If we take one of the large ailanthus leaves, with its long rachis and numerous leaflets, we are led to inquire into the manner of its numerical increase of leaflets. At a cursory glance at the leaves we find that although the vast majority are odd-pinnate, there are many which we are scarcely justified in calling odd, nor yet should we denominate them even pinnate. That is, transition stages between odd and even pinnate quite commonly occur, and I would call these "abnormal leaves" transition stages. They are the keys which will unlock for us the mystery of their development. Let us see if such is not the case: let us make use of these keys and thereby learn whether such is not the verdict rendered by the leaves themselves. We will put our queries to the terminal leaflets, because they seem to be the centre of evolutionary activity in nearly all pinnate leaves.

We have quite an advanced transition stage in Fig. 1 of our series; it has quite a conspicuous projection beyond the typical outline on the left side; a prominent vein is seen extending to the apex of this abnormal projection, from which

on the lower side, lead smaller, well-marked veins. There is also a very slight point on the opposite side of the leaflet, the venation here being similar to that just described What, then, does this abnormal leaflet mean? Can we not see that nature has decreed that there shall be an increase in the number of leaflets? And that she is about to "cut off" new leaflets from each side of this terminal leaflet!

Fig. 2 confirms us in this supposition, and furnishes an objective demonstratian of a more advanced transition stage. The sinuses have deepened, and the two lobes bid fair to become separate individual leaflets. We feel secure in making this statement because Fig. 3 stands ready to make good our word with a newly-added leaflet on one side and another on the other side, well under way. The rachis, meanwhile, has elongated to make room for the new-comer. Fig. 4 illustrates a repetition of this process of division, adding emphasis to our explanation of these "abnormal leaves." Nature is going right on, bent upon working out her conceptions to the fullest extent.

Nos. 5, 6, and 7 are certainly extremists. They may, perhaps, be compared with the impulsive, rampant reformers in the social world, who are imbued with a stronger progressive impulse than will harmonize with existing conditions; whose wishes to surmount all obstacles and soar aloft lead judgment and reason astray. The time is not ripe for

LEAFLETS FROM THE AILANTHUS TREE.

such prodigious strides, and much effort is therefore expended to little purpose. A few such leaders will occasionally be found among plants, fore-runners, as it were, of future attainment, and here we have leaflets which as yet have not even attained to an individuality of their own, taking upon themselves the work which legitimately belongs to the senior members of the family; if we may designate a leaf as a little family, and the leaflets thereof the individual members. No. 8 is such a senior member; that is, instead of a terminal leaflet it is from the base of the leaf. It is better able to take up the burden of secondary division than the mere baby leaflets that have not yet learned to take care of themselves. No. 8, however, may also be classed with the reformers, but with that more reasonable class who are not entirely beyond the ken of normal vision.

Would we not, therefore, be led to draw this conclusion from what we have said (and, I trust, demonstrated), that pinnate leaves are developed by a division of the terminal leaflet: the bi-pinnate leaf is evolved from the pinnate by the division of the leaflets, normally beginning in the lower or basal leaflets? That this is the law of division which holds among the majority of pinnate leaves is quite commonly demonstrated and verified by the leaves of various plants. The leaves of the trumpet creeper furnish as good illustrations of these various stages of transition as the ailanthus leaves.

There is but a slight point on the lower or outer portion of the typical basal leaflet of the ailanthus; this point is crowned with a small gland; here seems to be the starting-point of the new departure, which, according to the prediction of No. 8, will, in the course of time, result in the evolution of a bi-pinnate ailanthus leaf. This secondary division, as we have chosen to call the division of the lower leaflets, is illustrated abundantly by the common elder (*Sambucus canadensis*). So conspicuous, indeed, are the variations in the elder that it deserves a chapter on its own progressive efforts; it seems especially able to respond to favorable conditions.

MRS. W. A. KELLERMAN.

Columbus, Ohio.

SUGGESTIONS AS TO TEACHING BOTANY IN HIGH SCHOOLS.

THE teaching of botany in our colleges and higher schools during the last twenty-five years has had the unfortunate effect of bringing the science into disrepute, and of engendering in the minds of many who — as they would say — "took" it (like a dose of medicine), a thorough distaste for it. It is only within ten years that any radical change has taken place in the teaching ideals, and even to-day in many of the best institutions of learning, conservatism forces instruction into the old channels. The lower schools have travelled the same line, partly because they knew no better way, and partly because they were meeting the demands of the higher schools in the matter of preparation.

The radical defect of the older teaching lay in the failure to study the plants themselves; in the failure to treat them as living organisms; and in the failure to take into account the existence of other plants than the flowering ones. The ease with which plants could be collected and preserved by drying early led to the study of their external characters with a view to their classification alone. From the earliest times, therefore, almost to the present day, classification has been looked upon as the most important portion of the science of botany. Now, however, that the economic importance of the study of the physiology of healthy and diseased plants and of the causes of disease is coming to be more generally appreciated, it is high time that both in primary and secondary schools those portions of the science be taught which have a vital and vitalizing interest.

What Text-Book Shall We Use?

The first question that is usually asked is, "What text-book shall we use?" It is a difficult question to answer, and probably the best reply is, "Whatever text-book the teacher can use best." There is no book known to me which presents the subject in just the way that I consider most important. Probably the one of most general adaptability is "Gray's Lessons in Botany." If the teacher is capable of using them, either Bessey's "Essentials of Botany" or Campbell's "Structural and Systematic Botany" may be recommended. Wood's "Lessons in Botany," revised, is unfit for use on account of the numerous and misleading blunders which it contains. There should be in the school library, for reference, Gray's "Structural and Systematic Botany," Goodale's "Physiological Botany," Bessey's "Botany," and Goebel's "Outlines of Classification." Miss Newell's "Outline Lessons in Botany" will be found suggestive to the teacher who knows nothing of the method of study suggested herein.

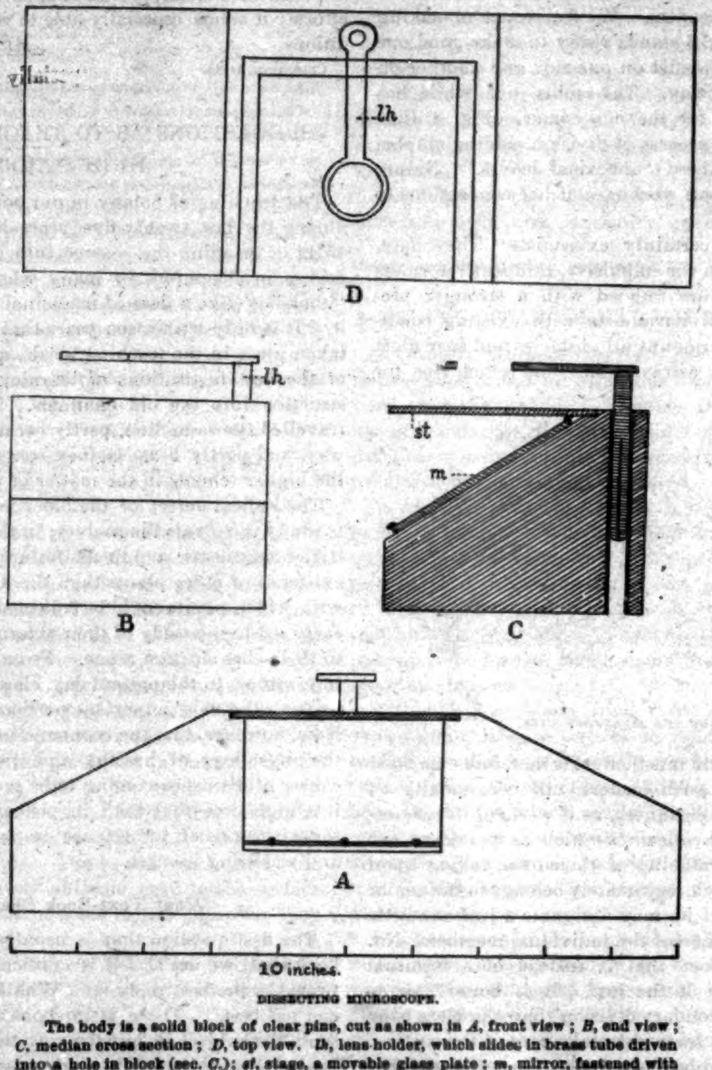
The suggestions here made are based on the supposition

that the scheme of studies proposed by the State superintendent is accepted, in which two terms are assigned to botany, beginning in the winter term. It is also presupposed that the School Board will be willing to supply the pupils with a proper room and a small amount of apparatus. I consider the providing of these quite as indispensable for the study of botany as furnishing a recitation room for mathematics with a blackboard and its accessories.

The room should be furnished with a sufficient number of common kitchen tables (those with unfinished tops are best), at which two students can work comfortably, and even four if crowded. The more windows the better.

The apparatus required is simple. Simple lenses with some device for supporting them while the hands are used in dissecting are needed The figures annexed show a most effective and low-priced dissecting stand which is in use in the University of Wisconsin and is to be preferred to more expensive ones. The block can be made by a carpenter for a few cents; the plain and mirror glass can be procured at the glazier's; the lenses and lens holders can be procured from the Bausch & Lomb Optical Co., Rochester, N.Y. The total cost should not exceed $1.75 If preferred, they may be procured of Mr. L. S. Cheney, Madison, Wis., at $1.75 for single stands, with a discount of ten per cent on orders for ten or more.

A deep individual butter dish is necessary for examining specimens in water. Each student should have a pair of needles (No. 6, "sharps") with the eye-end driven into soft pine handles. This can be done by holding the needle with a pair of pliers and forcing it in. The pupil should be required to provide himself with a sharp-bladed pen-knife, a rarer article than might be supposed.



DISSECTING MICROSCOPE.

The body is a solid block of clear pine, cut as shown in *A*, front view; *B*, end view; *C*, median cross section; *D*, top view. *lh*, lens-holder, which slides in brass tube driven into a hole in block (sec. *C*.); *st*, stage, a movable glass plate; *m*, mirror, fastened with small screws or tacks.

How to Get Material.

I should begin with a study of the flowering plants. There will be room for the exercise of some ingenuity in getting pupils to provide proper material for study by raising some and collecting some. Lima beans, sunflowers, and corn can be grown in pots or boxes; window gardens, greenhouses, and provision stores can be levied on until the spring opens. But it is better to have material collected in the summer and preserved in alcohol. Such material should be studied in water to prevent drying and to remove brittleness.

How to Begin.

It matters little what part is selected for a beginning. As the study commences in winter, the shoots of trees, two or more feet long, may be used. Select a tree in which the scars left by the fall of the foliage, leaves, and bud scales of the preceding season are quite conspicuous, such as the cottonwood, poplar, hickory, or horse-chestnut. Set the students at work to examine these before they have been assigned any study in the book. Have them examine all the markings they can find; compare the buds; study the relation between the buds and the scars; determine the extent of the preceding season's growth and of the season before that. When as much of the external anatomy has been seen as possible, let them carefully dissect the buds, studying the nature and shape of the scales; the character of their surfaces, whether hairy or resinous; the young foliage leaves for the next season; the young stem, comparing the shoot for the coming season with last season's growth, noting differences and resemblances. This dissection should be made partly by tearing off the parts, partly by cutting thin slices crosswise and lengthwise with the knife.

When the students have seen everything that they think there is to be seen, let them write a description of what they have observed. They should be asked to make this description as terse as possible, using their own language and not resorting to the book for terms.

The teacher should then examine these descriptions, in which he will doubtless find much omitted. I should then make the study of the same shoot the subject of the next class exercise, in which I should point out each feature that I wished examined, giving sufficient time for the inspection of each part. I should also endeavor to show that for the circumlocutions in their descriptions there are often single words (technical terms). The pupils will thus come to know something of the method of accurate and thorough observation, and will discover that technical terms are not hard words invented for their discomfiture, but short ways of expressing the ideas gained.

At the close of this exercise I should call upon each pupil to draw carefully a portion of the shoot showing as many of the facts observed as possible. Drawings should also be made of the dissected parts. Here the teacher will be met by the objection on the part of the pupils that they cannot draw; but as that is only another way of saying that they cannot see accurately, he will have to insist on their doing the best they can, with the assurance that as power of accurate observation increases the accuracy of the drawings will increase in the same ratio. He should be able to lead here as at other difficult places. Happy he if he be not a blind leader of the blind.

After studying several other shoots in the same way, I should assign the lesson in the text on buds and branching.

The points specially emphasized here are: 1. Study of the plants themselves. 2. Drawing and describing observations. 3. Afterwards the study of the text-book. 4. Supplementary reading, particularly as to the function of the parts studied.

Topics for Further Study.

Following this method with each organ, the following topics are suggested:

Underground stems: potato (tuber); onion (bulb); cyclamen or Indian turnip (corm).

Structure of stems: cut thin slices of both herbaceous and woody stems and examine in water. Bean, sunflower, geranium, hyacinth, and twigs of forest trees may be used.

Leaves: structure of blade and petiole; forms of stipules; character of venation, particularly with reference to function of veins. Reference readings on the function of foliage leaves are particularly important. Study of the unfolding leaves in spring is specially desirable.

Flowers: parts; forms; flower clusters, etc. I need enter on no details as to these parts, since they are treated so fully and have always received overmuch attention because of their importance to classification.

Let it be remembered in the study of all these topics that it is not a memorizing of the technical terms of descriptive botany that is wanted, but a study of structure of the parts with reference to function. Insist on the pupil constantly asking himself, "What is this for?" As to technical terms; if they are not acquired as a convenience they would better not be acquired at all.

Some time should be taken before the close of the year to study the lower plants. It is an excellent plan in the spring to organize "forays," on which pupils can collect every form of plant they can lay their hands on, ferns, toadstools, lichens, parasitic fungi, algæ, etc. Preserve these[1] and have them studied. Directions for such study can be found in Arthur, Barnes, and Coulter's "Plant Dissection" (Henry Holt & Co.); Bower's "Practical Botany" (Macmillan & Co.); Bessey's "Essentials of Botany" (Holt); Campbell's "Structural and Systematic Botany" (Ginn & Co.).

Questions will be freely answered regarding any matters not elucidated above, and further suggestions will be made if desired. I should be glad to be of assistance to teachers in improving the work in botany.

CHARLES REID BARNES,
Professor of Botany in the University of Wisconsin.

A NEURO-EPITHELIOMA OF THE RETINA.[2]

THE possibility of the reproduction of the most highly organized structure of the human body has long been doubted and even denied. Until the publication of an instance by Professor Klebs of Zurich, in which the ganglionic cells of the central nervous system were found repeated in a tumor formation, this was not admitted to be possible. Even now not a few competent pathological histologists are not convinced of its occurrence. An interesting and important addition to this subject is that of Dr. Flexner. In this instance the rod and cone layer and the external nuclear layer of the retina were reproduced in a tumor.

The case was that of a child four months old. One eye was affected and removed, and then the remaining eye became the seat of a disease presumably of like nature. But nothing was permitted to be done for the second eye. Several years before this child was born another child in the same family, this one six months old, died in consequence of an eye tumor which returned. Two years after the case just related another child of the same parents, this one four months old, had a tumor of the eye which spread to the brain, also resulting in death. The one which is reported makes, therefore, the third instance of eye tumor in this family. There was no history of eye tumor in the immediate ancestors of the children.

The vitreous chamber of the eye was filled almost entirely with the growth. The latter was attached to the retina throughout a considerable part of its extent, and was seen to originate at a point of microscopical size situated in the external nuclear layer. The cells which made up the tumor consisted of two principal kinds.

[1] Every teacher should have some book with directions for preserving plants. The following are available: Bailey's "Collector's Hand-book" (Bates, Salem, Mass.); Penhallow's "Botanical Collector's Guide" (Renouf, Montreal); Knowlton's "Directions for Preserving Recent and Fossil Plants" (Part B, Bulletin 39, U. S. National Museum).

[2] "A Peculiar Glioma (Neuro-epithelioma?) of the Retina," by Simon Flexner, M.D., fellow in pathology. From the Pathological Laboratory of the Johns Hopkins University and Hospital. The Johns Hopkins Hospital Bulletin, No. 15, 1891.

Those present in predominating number are probably not the entire cells, but are described as such for the sake of brevity. They present the appearance of sharply stained nuclei, with scanty, often indistinct, even apparently absent, cell bodies, and in favorable places their fibre-like processes can sometimes be traced a short distance from the cell bodies. These bodies often appear as round cells, and they are spoken of as such in this article, but they have a more complicated structure than this designation would imply. The next most important cells are larger than the round cells, but their nuclei are not larger than those of the round cells. These cells are usually of a columnar or rod shape, but sometimes they appear to be conical. The nuclei invariably occupy the broader ends of the cells, and each cell presents opposite to the nucleus an acute terminal process. Finally, from the extremity of the cells can sometimes be seen a stalk-like prolongation which passes down between the round cells and probably becomes united with them. The disposition of the various cells of the tumor is important. The columnar cells arrange themselves in the form of circles or rosettes, and this is accomplished through the juxtaposition of the sides of the cell bodies, the acute ends of the cells pointing towards the centre of the circle, while the periphery is formed by the broad ends of the cells containing the nuclei. The latter vary in size, depending on the number of cells concerned in their formation, and where the acute ends of the cells are in opposition, and just before their termination, a very fine, although distinct, membranous ring is formed, and projecting beyond this ring the delicate processes of the cells forming their acute ends may be observed. The round cells above described surround the rosettes. These tumor cells are in many ways identical in appearance with the external nuclei and rod and cone layer of the retina, as the author shows.

"If morphologically it is impossible to distinguish between the round cells of the tumor and the cells of the external nuclear layer of the retina, so do we consider that in each of the numerous rosettes can be seen the rod and cone layer of the retina reproduced in miniature. For it is possible to see in the membranous ring the external limiting membrane of the retina, beyond it, projecting into the lumen of the rosettes, the delicate processes of protoplasm corresponding to the rods and cones, and opposite to these the nuclei to which these processes are united And then surrounding these nuclei, which form a part of the external nuclear layer, as it were, are the numerous round cells which are indistinguishable from the cells of the external nuclear layer. It is not to be considered that in every rosette the matured rod and cone layer of the retina is reproduced· While this is the case in some of them, others show a structure suggesting the embryonic type. Hence this tumor is regarded as one in which the two most external layers of the retina have been reproduced."

The second part of the paper is devoted to a discussion of applicability of the term "glioma" and the suggestion of the name "neuro-epithelioma," and then with a consideration of the question of the embryonic origin of tumors in general.

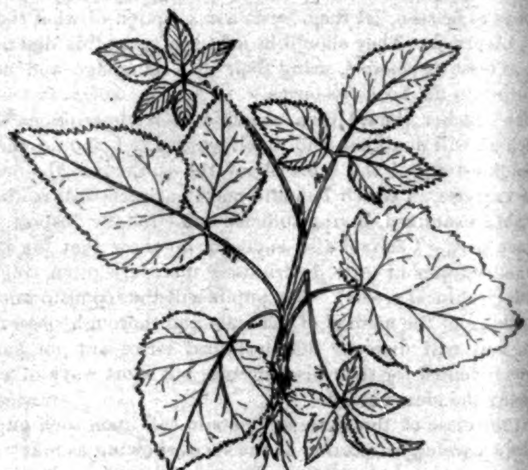
A SEEDLING BLACKBERRY PLANT.

WHEN poor little "Jo" of Bleakhouse was told to "move on," he did not appreciate the fact that everything in nature is impelled by irresistable forces to "move on" to a higher plane of existence, or suffer the only alternative, extinction. Plants and animals must be able to respond to changed conditions, must adapt themselves to their ever changing environment by various modifications.

Grant Allen has written some exceedingly interesting chapters on the genealogy of certain plants. Nature seems to have dropped a magic key into his hands, which admits him directly into her presence, and he relates with charming grace what she imparts to him. Although it requires a skilled expert to "Dissect a Daisy," any one who will, may read the fascinating story of evolution which is written on the leaves of many plants.

Now, here is a little seedling blackberry plant, which we will take for our text. You will notice at the merest glance that the leaves are quite dissimilar. The one nearest the base being simply a plain, ovate leaf, with an irregularly serrated margin. I wish you to notice particularly a certain peculiarity in the venation of this leaf, viz., that the first pair of veins near its base are quite prominent; that, leading from these veins on the lower side, are also well-marked veins; while on the upper side there are none, or very inconspicuous ones. There does not seem to be anything striking or of especial interest in these facts, but, like the "magic pear," which the artist, with a few strokes, converts into a face, this peculiarity becomes gradually emphasized, until later on in the series it may be called a characteristic.

The second leaf differs somewhat from the first one, the outline is more irregular. If, however, we read just a little between the lines, we will see that it really has taken quite a stride in advance; a little more careful examination will reveal, what perhaps escaped our notice at first, that the difference between these two leaves does not consist wholly in difference of outline. Again, it will be observed, the



A SEEDLING BLACKBERRY PLANT.

pair of veins near the base of the leaf are prominent, the smaller veins leading from them being also well-marked, on the lower side only.

With a little imagination, we can perceive that Nature is busy at work with this "magic leaf," and has already conceived the idea of evolving from it the trifoliate leaf. With this idea in mind, we can readily understand the significance of the prominent veins, to which your attention has already been called. We may consider them the frame-work of the undeveloped leaflets. A notch is quite plainly seen on each side of this second leaf, which nature evidently wishes to continue and deepen until a new leaflet is given off on either side. As if to render this result more easily accomplished, she has omitted the frame-work in the portion of the leaf where division is to take place. As proof that our imagination has not led us astray in our prediction as to nature's plan, we have leaf No. 3 of our seedling. This leaf has actually given off a leaflet on one side, and is evidently husbanding its forces for the elaboration of another on the opposite side, the outline of which is already suggested by the characteristic venation on the lower or outer portion. We may almost say that half the leaflet is even now evolved.

Nature had these little leaflets in mind long before she brought them forth, as shown by the veins on the first leaf of our little seedling.

But let us return to the perfect leaflet, which has been given off and now enjoys the responsibility of individuality. Observing it carefully, we discover that nature has planned a repetition of the process of division. Leaf No. 4 demonstrates the progress of this conception. The new leaflets can be readily perceived, though they yet live with the mother leaflets, if we may so designate the latter, which continue to elaborate nourishment for their offspring until they no longer need direct parental care.

In leaf No. 5, nature has almost reached the highest type of blackberry leaf of the present. In it, the fifth leaflet is about to bid adieu to its mother-leaflet; it stands on the threshold of individual existence; soon it will reach maturity and have a petiole all its own. The truth of this assertion is demonstrated by leaf No. 6, which represents a normal blackberry leaf, with five fully developed leaflets.

Nature never does anything in a hurry. Whether it took ages or æons to evolve the five leaflets from the single leaf we do not know, but he who runs — through a blackberry patch — may read on every plant or bush some chapter of the story of evolution she has written on the leaves. The single leaflet will not be met with so commonly, but various stages of transition, from three to five leaflets may be found on any blackberry plant.

Agassiz insisted that the laws of geological succession and embryonic development are the same, that embryology, or the development of the individual, is an epitome of the development of the entire series. In the leaves of the seedling blackberry we have, as it were, an epitome of the evolution of the blackberry leaf from the ancestral form to the present type.

The social world is sometimes disturbed and startled by the appearance of a reformer, who casts from him superstitions, dogmas, old beliefs, and mounts to a higher mental plane. So, too, there are reformers among plants; for instance, a blackberry leaf of six or seven leaflets is sometimes found; it is true such leaves are considered monstrosities, or abnormal specimens.

If we again permit ourselves to read between the lines, will we not be able to see in these abnormal leaves that nature is at work now as in the past? Favorable conditions and hereditary influence are now, as formerly, the tools she furnishes her favorites for working out their evolution.

The trifoliate leaf existed in embryo, as it were, in our ancestral seedling leaf. Nature said, "Move on!" When the whole brotherhood had reached the dignity of the perfect trifoliate leaf, she bade them still "move on!" All have not yet attained to the degree of progress represented by the five leaflets. But nature will continue to "move on," and the occasional reversions and reformers are the sign-boards which indicate to us the road she has taken.

MRS. W. A. KELLERMAN.

Columbus, Ohio.

NOTES ON THE FOOD OF THE BOX TORTOISE.

SEVERAL years ago, walking one morning in a wood in Pennsylvania, I surprised a wood turtle or box tortoise eating his breakfast. The season had been rainy, and many varieties of large fungus had attained a prodigal growth. The woods were full of what are popularly called toadstools; many of them were of the diameter of a tea plate, and stood five or six inches high. As I walked through the wood I observed that many of these fungi had been gnawed off evenly, as if cut by a knife, leaving only the central pillar intact. What had done this? I soon discovered, for moving noiselessly over the mossy earth, I came to a little opening, where grew one of the finest of these toadstools, and there was a wood turtle taking his breakfast.

The animal had already made one or two rounds of his plate, and was eating with praiseworthy deliberation. He would bite off a mouthful of toadstool, chew it carefully until he had extracted all the juice, then open his mouth and drop out the chewed fibre, and take a fresh mouthful, biting not inward toward the stem, but breaking off the morsel next beside that which he had just eaten. He paced round and round the fungus as he took his bites, eating his plate like Æneas and the other Trojans, and as the fungus decreased in regular circles the circle of chewed fragments increased. In three quarters of an hour he had eaten all the disk of the fungus to the stem part, and then he walked slowly off to look for another.

I found the crumbs that had fallen from his vanished table quite dry, nothing nutritious being left in them. Why he rejected the central part of the fungus and the stem I could not imagine, but he left it in every instance. If he came upon a decayed or wormy portion of the toadstool he did not "bite round it," but abandoned it altogether and went for a fresh one.

Last summer I took home with me a box tortoise to experiment on feeding it. He ate flies and other insects from my fingers at once, showing no signs of fear; he ate bread and milk with evident relish. I put a blackberry in his open mouth and he closed upon it, but at once, with every appearance of deep disgust, stretched his mouth wide open, and, taking his right front paw hand-wise, wiped all the berry from his mouth. He repeated this performance many times, both with blackberries and blueberries, always using his right paw to cleanse his mouth.

J. MCNAIR WRIGHT.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

Hypnotism among the Lower Animals.

THE power attributed to the snake and feline families, of "charming" their victims, seems to me past dispute. Is it not merely a form of hypnotism? Livingston tells us that when at one time seized by a tiger, he felt neither terror nor pain, all his senses seemed to be benumbed. Bates, in his "Naturalist on the Amazons," states that one day in the woods a small pet dog flew at a large rattlesnake. The snake fixed its eyes on the dog, erected its tail, and shook its rattle; it seemed in no haste to seize the dog, but as if waiting to put the dog into a more suitable condition for being seized. As to the dog, it neither continued the attack nor retreated, could not or would not move when called, and was with difficulty dragged away by its master.

I have seen one case of a snake charming a bird, but I had a better opportunity to study a cat charming a bird, and probably the process is much alike in both.

The cat placed itself on the outside sill of my window, near to a pine tree. A bird presently lit on the pine tree, no doubt not observing the cat. The cat fixed its attention on the bird. The cat's eyes were widely opened, and shone with a peculiar brightness; its head was raised and intent, the fur on its neck and about its face slowly stood up, as if electrified. Except for this rising of the fur, and a certain intensity of life in the whole attitude of

the beast, it was as still as if cut from stone. The bird quivered, trembled, looked fixedly at the cat, and finally, with a feeble shake of the wings, fell towards the cat, which bounded to seize it.

A lady tells me that she "does not believe that cats can charm birds, because she has seen a cat try to charm a parrot, and the bird, greatly alarmed, scolded loudly." This proves nothing, the parrot in general, or, more probably, that particular parrot, did not prove a good subject for the mesmeric power. I have seen people who cannot be hypnotized; they resent the effort, and nervous action becomes intensified. J. McNair Wright.

AMONG THE PUBLISHERS.

The W. J. Johnson Co., limited, have ready "The Electric Railway in Theory and Practice," a complete treatise on the construction and operation of electric railways, by O. T. Crosby and Dr. Louis Bell, fully illustrated and wholly practical.

—Henry Holt & Co. will shortly publish a translation of "Geschichte der Philosophie," by Dr. W. Windelband, professor in the University of Strassburg.

—Thomas Nelson's Sons have ready an entirely new atlas by J. G. Bartholomew, entitled "The Graphic Atlas and Gazetteer of the World," with over two hundred and twenty maps, charts, plans of cities, etc., all revised to present date, and a gazetteer of nearly 55,000 places and results of new census. Throughout the atlas the countries of the world have been treated with fulness in proportion to their commercial importance and interest. In the United States section a separate map is given of each of the States and Territories. The Canadian provinces are treated in similar detail. The maps have been specially compiled from the latest and best government survey maps, and have undergone local revision for the verification of new counties, townships, and railways. Considering the vast amount of information given, the atlas is a marvel of compactness and practicability.

—The most important work on the general study of linguistic science that has appeared in 1891 is that of Professor Georg von der Gabelentz, "Die Sprachwissenschaft, ihre Aufgaben, Methoden und bisherigen Ergebnisse," Leipzig (Weigel, publisher), pp. xx. and 502. The wide-reaching and comprehensive scope of this treatise is shown by the very title, and readers will soon see that the author fulfils what he promises. Through his great practical experience the author, well known as a connoisseur of eastern Asiatic languages, is enabled to give more hints about linguistic studies and their scientific bearing than such men as have confined their energies to inflective languages alone. The volume gives us the views of a man familiar with all possible types of human speech, the monosyllabic as well as the incorporating and agglutinative, and introduces us in the most fascinating way into all the morphologic intricacies of the verb, noun-verb, and sentence. In its make-up the book comes nearest the celebrated "Principles of Language History," by Paul, and supplements it in many different

CALENDAR OF SOCIETIES.

Women's Anthropological Society of America, Washington.

Feb. 6.—Child Life.

ways, as it does also the works of Friedrich Müller and Whitney. There is no chapter in language-study which is not fruitfully hinted at or fully treated by the author: the composing of grammars, the analytic compared with the synthetic system, the various phonetic modes of recording languages, the medley languages, theory of roots, the tests of affinity, the possibility of composing scientific dictionaries, the analysis which is inherent in etymologic research, synonymic dictionaries, etc."

—Dr. Andrew D. White will open the March *Popular Science Monthly* with a chapter on "Astronomy" in his Warfare of Science series. The strenuous exertions made by both the Catholic and the Protestant clergy to suppress the teachings of Copernicus and Galileo are set forth in this article with such strong evidence as to admit of no denial or shifting of responsibility. "The Organ" will be the subject of the article in the American Industries series. The author, Mr. Daniel Spillane, describes some of the noted instruments in the United States, and shows that American organ builders have made good use of the scope for individuality which their art allows. The article is fully illustrated. Under the title "Social Statistics of Cities," the March number will have a paper by Carroll D. Wright, comparing the area and population, and the cost of each department of public works, in fifty cities of the United States. The comparison contradicts some prevailing opinions as to what cities have the most expensive governments. "The Cotton Industry of Brazil" will be described by John C. Branner, formerly assistant geologist of the Brazilian Geological Survey. Mr. Branner believes that the production and manufacture of cotton in Brazil is destined to increase, but that the country will not become a competitor of the United States in this industry.

—"Darwin after Darwin," is the title of a book that George J. Romanes is preparing.

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